



## D.18 Changes in SATURN 10.9

### DATE OF LAST UPDATE: 13<sup>th</sup> AUGUST 2011

**SATURN** 10.9 was first released in pre-Beta version in December 2008 (with purely temporary version numbers 10.9.1, 10.9.2 etc.) and as a full release (official 10.9.12) in November 2009. Further full or partial releases were made as 10.9.15 in February 2010, 10.9.17 in June 2010, 10.9.22 in January 2011 and (finally) 10.9.24 in May 2011.

Significant new features include new style .UFC files (see note 4, D.18.2), phased in blocking back (note 6, D.18.3) and explicit flared lanes (note 4 in D.18.1 and note 9 in D.18.3). Try them out!

With respect to flared lanes (see 6.4.9.3 and 8.2.6), a word of caution is required: their introduction in 10.9.22 was based on a relatively early stage of development and a number of consequent corrections and/or improvements were made in 10.9.23 and 10.9.24 (note 12 in D18.3). Post 10.9.24, while the added impact of flared lanes seems to be “sensible” in all situations tested to date, there will almost certainly be unlikely combinations of circumstances arising at some point in the future which will lead to unrealistic results and which will necessitate further changes to the modelling. Users are strongly encouraged to include flares in their data coding – but with care!

In terms of backwards/forwards compatibility the 10.9 network .dat files contain several new features (e.g., parameter names) which will **not** be recognised by pre 10.9 versions of **SATNET** but will not cause the program to crash; however pre 10.9 .dat files will be read perfectly happily by 10.9. Similarly 10.9 network .ufs files contain new arrays which older version exe's will be able to read but not recognise whereas 10.9 exe's will be able to read pre 10.9 ufs files. Matrix .ufm files have not fundamentally changed and should be both forward and backward compatible.

In terms of results there have been a large number of both relatively major and minor changes to the simulation so that one might expect 10.9 to give different – possibly significantly different – results to pre 10.9. For this reason the opportunity has been taken to change the default values of a number of parameters, typically options that were introduced in recent releases but “turned off” by default are now “turned on” having been verified in practice. E.g., see note 10) under **SATNET**.

Our advice therefore would be to re-run old networks “from scratch” and certainly not to do comparisons between 10.9 outputs and pre 10.9 outputs.

The following sections describe the changes made in **SATURN** 10.9, some of which were also included in version 10.8.21 and/or 10.8.22 and listed in Appendix D-17.



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### D.18.1 SATNET

- 1) A check is made whether LTP has been explicitly set in the &PARAM records in the network .dat file and, if not, a warning message is printed. This follows from the fact that the default value, 30 minutes, is probably **not** the preferred value for most applications. See 8.4.5.
- 2) Extra checks on network connectivity have been added: (a) on the assignment network (previously included as Warning 47 but only if EXPERT = T and PRINT = T); (b) the map network and (c) O-D pairs in the trip matrix for which no route exists (previously included within **SATALL**). Non-Fatal Errors 277 and 278 have been added to cover (c) and (b) respectively with both upgraded to Semi-Fatal Errors under WRIGHT = T. See 5.5.4.
- 3) Q105 and RB106 are now always assumed to be .TRUE. within the programs. Ditto LCR108. So, in effect, they are no longer parameters and changing their values in a network .dat file has no effect. See 8.4.7, 8.7.3 and 8.4.4.
- 4) The presence of a flared lane (or lanes) at either signals or priority junctions is indicated by an F within the lane field (columns 11 to 15 of the first link record). Both nearside and offside flares may be represented. 10.9.20. See 6.4.9.3.
- 5) &PARAM parameters FLAREX and FLAREF have been added to represent the default length (in units of PCUs) of offside/nearside flares. But see note 26) below as well. See 8.2.6.
- 6) Link-specific TAX values may now be added at the end of the (first) simulation link data record – although another new method for including it on the second link record (see note 26 below) is preferred. See 6.4.15.
- 7) New advice is provided on the tricky problem of coding extra “pseudo” lanes for X-turns at signals and/or flared lanes which makes maximum use of the new TAX and FLAREX options above. See 6.4.9.4.
- 8) Allow clear exits – priority modifier C – for filters at signals. See 6.4.2.6.
- 9) Warning 13 – not all obvious roundabout turns coded – is now Semi-fatal under WRIGHT = T as is non-fatal error 234 – an X-turn at signals which is unopposed.
- 10) The default values for RTP108, MONACO, AUTONA, AUTOK and AUTNUC are changed to .TRUE. (but, unlike Q105 etc. above, they still have an effect if turned to .FALSE.). See 8.6.3, 8.2.5, 9.5.4, 9.3.1 and 15.15.2 respectively.
- 11) \$INCLUDE may now have a time period subscript; e.g. use “\$INCLUDE(3) file” if file is only applicable to time period 3 in a multiple time period .dat file. See 15.30 and 17.4.4

- 12) Default for NIPS set to 2, 19/01/09. See 9.12.2.
- 13) A new logical parameter BANKER has been added which, if T (default is F), outputs an ascii file with extension .BNT with a complete list of banned turns including both U-turns and turns into non-exit 1-way roads in addition to explicitly banned turns under either 11111 or 44444 data inputs. Also in 10.8.21. 29/01/09.
- 14) The rules for defining KNOBS data (in particular tolls) on simulation centroid connectors have now been relaxed so that it is possible to define a simulation centroid connector by its zone number and a **single** node number, i.e., the two numbers at either end of the dashed CC lines on network plots, the obvious way to define them. However, strictly speaking, simulation centroid connectors need a zone number plus two node numbers to define a link but this is difficult and counter-intuitive. Indeed the use of "wildcard" entries (zone only) is strongly recommended. See 15.14.5. 20/03/09. 10.9.5.
- 15) A new &OPTION parameter PLFF3 has been introduced such that, if TRUE, links in a text file containing pre-loaded flows (hence PLODFF = T) need only be defined by an A-node and B-node; i.e., no 3<sup>rd</sup> field containing a 0 is necessary in order to distinguish turns from links. See 15.5.4.
- 16) A new parameter DCSV allows default buffer speed-flow curves by capacity index to be defined in free format within the 33333 data records. This eliminates potential problems of column definitions when DUTCH = F or T. See Note 4) in 15.9. 10.9.5. 07/04/09.
- 17) A new algorithm is used to estimate better values of XYUNIT by comparing input coded distances with calculated crow-fly distances by excluding: (a) links which only lead to zones and which may well have artificial distances and (b) obvious outliers. 10.9.6. 25/04/09
- 18) A new method to interpolate missing X,Y node co-ordinates has been added to cover the situation where there are **two** undefined nodes on links between two defined nodes (as opposed to just one previously). 10.9.6. 26/04/09.
- 19) The default value of the &PARAM parameter CROWCC has been changed to .FALSE. in order that, by default, buffer centroid connector distances which are input as zero are not re-set by their crow-fly distances. See 15.10.3. 10.9.8. 10/07/09.
- 20) The network coding practice of sub-dividing a link into a short series of 2-arm "artificial" nodes (e.g., to give it "shape") has now been formally identified as a "chain" of nodes with applications to blocking back, random delays, etc. etc. where we expect the series of links to function as a single link in some respects. More complicated examples of the same basic phenomenon are also identified. See 5.1.12 and 8.5.5. Chained links may also be displayed within **P1X**.

- 21) User-class specific values of SUET (virtually never used) may now be defined as a subscripted &PARAM Namelist variable. E.g., SUET(2) = 0.5 sets the value of SUET for user class 2 only. See 7.3.3. 10.9.10. 12/08/09.
- 22) A new parameter FREE88 allows the values of PPM, PPK and KNOBS weights per user class to be input in free format – so as to avoid problems with trying to define values within 5 columns. See 6.11, note 12). 10.9.10. 12/08/09.
- 23) MYTVV, which selects the algorithm used for signal optimisation, now defaults to 5 rather than 1. The differences should be slight. See 15.31.3. 10.9.10. 12/08/09.
- 24) Maximum free-flow speeds (CLICKS) disaggregated by both vehicle class and capacity index (KLUNK = 1) may now also be defined by including single records with a V in column 1 under the 33333 buffer data records as an alternative to using an external FILVSD file. See 15.47.2. 10.9.10. 13/08/09.
- 25) An alternative algorithm for interpolating between two non-connected nodes in a bus route based on minimum distance has been created. It may be used if the normal direct-line method fails provided a parameter MINDER = T. See 15.18. 10.9.10. 14/08/09. Equally the direct-line method has also been improved, in particular to avoid “diversions” down spigot zone connectors.
- 26) The simulation link record 2B, which previously has been used to define simulation link speed-flow curves, may now also be used to define link-specific values for TAX, FLAREF and FLAREX. See 6.4.14. 10.9.10. 17/08/09.
- 27) The default value of NITS (maximum number of simulation iterations) has been increased from 10 to 20. See 8.1. 10.9.10. 29/08/09.
- 28) The default for NITA\_M has been reduced to 1 under OBA (but is still 3 under Frank-Wolfe). 10.9.13. 30/11/09.
- 29) A new Serious Warning 138 has been added to detect roundabouts where, e.g., the saturation flows coded for two or more arms are the same but the number of lanes differs. Strictly speaking, it tests for significant differences in saturation flow per lane between different arms. See 6.4.7. 10.9.13. 5/12/09.
- 30) Another new Serious Warning 167 tests for centroid connectors from a buffer zone which are, e.g., coded as 2-way but the out-bound link(s) from the buffer node is 1-way. See 16.6.4. 10.9.13. 5/12/09.
- 31) A new Warning detects possible simulation nodes where there appear to be sufficient links on an outbound arm to justify using a Clear Priority Modifier on an exit turn. See 6.4.2.6. 10.9.13. 06/12/09.

- 32) Incorrectly including &PARAM namelist variables within &OPTION now results in a Fatal Error 486 (in the same way that including &OPTION variables under &PARAM is currently FATAL 486). 10.9.14. 10/12/09.
- 33) The output .bus files produced if BUSKER = T are now consistently either 10 nodes per line or 13 nodes per line depending on whether there are 5-digit nodes **anywhere** in the network or not, not just on the individual routes. 10.9.14. 19/01/10.
- 34) Bus-lanes may now distinguish between bus-only lanes, tram-only lanes and bus-or-tram lanes by using the letters B, S and T respectively on simulation link records. 10.9.15. 01/02/10.
- 35) An alternative, more natural, set of TOPUP rules has been introduced whereby the data input for simulation nodes may be duplicated in \$INCLUDE files via a parameter DOUBLE = T under &PARAM. This makes it easier to create alternative scenario networks based on a master version. The default value of T is strongly recommended. See 6.15.2 and 6.15.3. 10.9.15. 04/03/10.
- 36) Various Warning messages which create Semi-fatal errors under WRIGHT = T have been upgraded and renumbered as Serious Warnings. Thus Warning 13 becomes Serious Warning 168, 17 to 169, 76 to 176 and 77 to 177. Thus none of the remaining Warnings become Semi-Fatal under WRIGHT = T, only certain Serious Warnings and Non-Fatal errors. 10.9.16. 07/04/10.
- 37) In addition the set of Serious Warnings and Non-Fatal Errors which **are** upgraded to Semi-Fatal under WRIGHT = T has been increased significantly. For a full list see Appendix L. 10.9.16. 07/04/10.
- 38) If a negative stacking capacity is input in field 1 (columns 1 – 5) on a simulation link record for link A-B this is taken to imply that that link should not be considered to be part of a set of in-series 2-arm links for blocking back purposes but is to be allowed to block back in its own right. See 8.5.5.4. 10.9.18. 04/07/10.
- 39) Warning 24 – an input time or speed which is out of range – has been expanded to distinguish the situation where the input value is **zero** as a Serious Warning 170. 10.9.19. 21/08/10.
- 40) A range of values for ERRYES may be set in a single Namelist statement by using a colon; e.g., ERRYES(33:66) = F “turns off” all warnings in the range 33 to 66. See Section 2.9 and Appendix A. 10.9.19. 22/08/10.
- 41) ERL files which contain a full list of errors found within **SATNET** and sorted by node order are automatically output and may be subsequently processed by users. They may also be used to help identify “new” error messages. See 15.58.

- 42) Timing point routes which have a frequency of zero (as is normal) are now always modelled as beginning at the first coded (simulation) node and terminating at the final coded node as if, in effect, UPBUS = T, independent of the actual value of UPBUS. This is a more “natural” assumption but means that the modelled timing points may differ within, e.g., Validation statistics in **P1X**. However it also means that timing points defined at the **final** node are always accepted. See 6.9.5 and 11.7.2.2. 10.9.24. 28/04/11.

### D.18.2 SATALL

- 1) Extra warnings, Serious Warnings and Non-fatal errors identified within **SATALL** have been added to the lists produced by **SATNET** so that the lists of errors displayed in, say, **P1X** now includes errors from both **SATNET** and **SATALL**.
- 2) If MASL = 1 and SAVEIT = T the output .UFC file is always based on the actual (single) assignment, not an extra SAVEIT assignment; see also UFC109 under 4). 15.23.2.
- 3) The default value for UNCRTS changed to 0.05 from 0.2.
- 4) A new option UFC109 has been introduced and set under namelist &PARAM in network .dat files. If UFC109 = T (default = F) two things happen.

Firstly, the output .UFC file under multiple user classes stores the sets of link **times** per iteration as opposed to link (generalised) costs by both iteration **and** user class. This is possible because the times per iteration are constant between all user classes on the same Frank-Wolfe iteration; the costs may differ but only because the fixed costs per user class differ however, since the fixed costs are fixed throughout (by definition), it is straightforward to construct the costs per iteration/UC by adding (stored) times per iteration to fixed costs by user class. This means that the .UFC files produced under UFC109 will be reduced in size by a factor of 1/NOMADS with only a very small overhead in reconstructing costs as required for secondary analysis. Note that for a single user class we continue to store costs, not times, since there is no difference in file size and it would only save a small overhead.

Secondly, the costs/times may be stored as a rolling summation of **all** Frank-Wolfe iterations over **all** simulation-assignment loops instead of re-creating the assigned route flows by an extra SAVEIT iteration. This has the benefit that any secondary analysis, e.g., skimming, based on routes is exact, not an approximation. The dis-benefit is that there may be many more rolling iterations in total than there would be in a SAVEIT assignment which means that: (a) the.UFC files are larger and (b) any secondary analyses take longer. However, if the number of rolling iterations becomes too large (greater than NITA\_C – see below) then we revert to an extra SAVEIT assignment. See 15.23.3. 10.9.5. 04/04/09

- 5) A new &PARAM integer parameter NITA\_C sets the maximum number of rolling FW iteration costs/times which may be stored in a .UFC file when UFC109 = T. See 15.23.3. 10.9.5. 04/04/09.
- 6) The choice of convergence rules set by KONSTP has been extended to allow the combination of either the ISTOP link flow criterion with a maximum cpu time or minimum GAP value with maximum cpu time. Both are more sensible than simply setting a maximum cpu time on its own. See 9.3.2. 10.9.5. 05/04/09.
- 7) The possibility that a run of **SATALL** may terminate with error level 2 (indicating that it has converged only on the maximum number of loops MASL, not, e.g., on ISTOP) has been removed. Previously STOP 2 might cause a long batch file run to hang. 10.9.5 and also 10.8.22. 08/04/09.
- 8) A new command line parameter QUICK, if used, artificially reduces all loop etc. counters such as MASL, NITA, NITS etc. to minimal values so that the program runs in minimal CPU. Useful for checking if long batch files have been set up correctly. See 14.10. 10.9.7. 13/05/09.
- 9) The option AUTONA, in addition to potentially adjusting NITA at each loop, now also sets UNCRTS in order to allow the assignment to converge better. 10.9.8. 30/06/09.
- 10) New advice is now provided in the manual on the choice of stopping criteria for the assignment-simulation loops. In brief our recommendation is to use a Gap value rather than %FLOWS (although the preference is fairly marginal). See the discussion in 9.2.3. 14/04/10.
- 11) Disaggregated cpu times broken down by, e.g., simulation and assignment, now include explicit times before and after the main loops (basically inputs and outputs). These are printed at the end of the .LPT files. 10.9.17. 12/06/10.
- 12) The calculation of the optimal step length used under AUTOK to average two assignments based on the simulation has been "improved" so that it should take fewer iterations to identify the optimum. See 9.3.2.1 10.9.17. 01/06/10.
- 13) The order in which the nodes are considered within a single internal simulation iteration has been changed so that instead of simply taking them in a pure numerical order a topologically-based strategy of working from the outside of the network inwards has been adopted. In principle this should reduce the number of required internal iterations. See 8.3.4. 10.9.17. 01/06/10.
- 14) If AUTONA = T the value of UNCRTS used during the SAVEIT assignment is set equal to the **minimum** value of UNCRTS as adjusted (downwards) by AUTONA during the assignment-simulation loops in order to make the assignment convergence comparable to the minimum GAP value. This, in

turn, will therefore help to improve the convergence of the SAVEIT assignment and make it more comparable to GAP as well (at the cost of extra CPU time). See 9.5.4 and 15.23.2(4). 10.9.18. 03/08/10.

- 15) The method by which **SATALL** (and **SATEASY**) store trip matrices in internal memory may be made more efficient by setting a network parameter **SPARSE = F** if more than 50% of the trip matrix cells are likely to have positive values (i.e., the matrix is not "sparse"). This avoids problems of potential crashes due to insufficient array lengths. See 7.11.12. 10.9.21. 11/11/10.
- 16) If negative cells are found in the trip matrix and a Serious Warning generated then, in addition to messages output in the .LPT file (which no one ever looks at!), the warning 172 is recorded in the output .ufs file where it could be printed by **P1X** etc along with all the other errors detected by **SATNET**. 10.9.21. 19/11/10.
- 17) New rules are applied to the use of **SATOFF = T** coupled with **MANOFF** (a fixed master node to define relative offsets) such that all signalled nodes that do **not** have the same cycle time as **MANOFF** do not have their offsets adjusted. 10.9.23. 01/02/11.
- 18) If the input network .UF file was created by a program (i.e., **SATNET**) which is from a **later** release version of **SATURN** then **SATALL** will fail with a fatal error in order to avoid any possible problems of non-upwards compatibility. 10.9.23. 01/02/11.
- 19) The printing of simulation summary statistics to the .LPT file has been reduced so that statistics disaggregated by, e.g., capacity index, are not included. 10.9.23. 15/02/11.
- 20) The "sub-procedure" within **SATALL** which creates a .UFO after an assignment has already been run has been extended for multiple user classes so that a single user class .UFO file may be created. In particular this option may be invoked by a distributed multiple processor procedure **SATUFO\_MC** which creates separate .UFO sub-files using separate processors before merging them all into a single .UFO file. See 15.23.7 and 15.53.2.7. 10.9.24. 22/04/11.
- 21) A Multi-Core version of Network Aggregation (**SPIDER=T**) released to all existing Multi-Core users as part of the standard **SATALL** release. 10.9.24 31/05/11

### D.18.3 Simulation

- 1) The method for calculating random delays upstream of links which block back has been modified so that the capacity used in the formula is the capacity BEFORE blocking back was applied. This removes a possible discontinuity when the link downstream goes from a state of blocking back to not blocking back or vice versa. See 8.6.5.

- 2) Arrays of simulation turn delays broken down by: (a) V>C permanent queues, (b) random delay and (c) CFP only have been created and may be accessed within **P1X**.
- 3) Random delays are **not** included on links which are part of "internal" chains of 2-arm "artificial" nodes. See 8.6.4. 10.9.7. 01/06/09
- 4) The equation used to define delays on Q-turns has now been "parameterised" in the sense that the numerical constants 226 and 0.75 (see Equation (Q-10) in Appendix Q) may now be user-set via Namelist parameters QDMAX and QVCMIN under &PARAM.
- 5) The rules for blocking back on links which have been artificially sub-divided into one or more continuous sub-links (e.g., to provide a link "shape" via 2-arm dummy nodes) have been made more general. Set BB109 = T to invoke the new rules. See 5.1.12 and 8.5.5. 10.9.9. 25/07/09.
- 6) Blocking back may also now be "phased in" when the queue on the link is only slightly smaller than the stacking capacity by setting BB109 = T and BBKING < 1.0 See 8.5.6. 10.9.9. 25/07/09.
- 7) The calculation of capacities for X-turns at signals – and of any turns with which they share lanes – has been extended by the introduction of an explicit length of flared lane denoted by FLAREX. See 8.2.5.2 and 8.2.6 plus notes 4) and 26) under **SATNET** D.18.1 above. 17/08/09.
- 8) The rules governing a Y-merge and whether or not it is subject to "funnelling" have been slightly updated in 10.9.18 which will therefore give slightly different results from previous releases. See 8.8.4.4. 25/07/10.
- 9) Flared lanes are now explicitly modelled in terms of increasing the capacity of those turns which are allowed to use flared lanes. See 8.2.6. 10.9.20. 15/09/10.
- 10) The rules for the reductions in capacity due to weaving on links **between** "motorway" junctions (see Section 15.40) have been extended such that if there is more than one link between the entry and exit ramps (as illustrated in Fig 15.3) than the reduction factor is applied to **all** those links; previously it was only applied to the last link. 10.9.23. 20/02/11.
- 11) The rules for applying an additional delay at Q-turns (App. Q) have been modified such that if the Q-marker is within a link weaving section then the saturation flow used in equation (Q.1) is reduced by the weaving factor in order to produce a larger delay. See also 15.40.4.5. 10.9.23. 20/02/11.
- 12) Post 10.9.23 the rules for modelling flared lanes (either X or F) at priority junctions have been upgraded, basically increasing the capacity, in particular when queues are near to or greater than flare lengths, and correcting a potential instability (see note 44 in Appendix E-6). Equally other



modifications, possibly less extreme, have been made to the modelling of flares at traffic signals. 10.9.23. 16/03/11.

#### D.18.4 SATME2/SATPIJA

- 1) Certain errors in input in the control file have been upgraded to semi-fatal and result in the program being terminated once it has got to the end of the inputs.
- 2) Extra warning messages have been added if (a) the number of frozen cells appears to be too large and (b) if the total number of trips changes significantly post ME2.
- 3) A summary table of stats per internal iteration – Table 9B – is included at the end of the internal iterations. 15/01/09.
- 4) Zonal constraints (input data segments 22222 and/or 33333) may now be duplicated in the sense that a GT and a LT constraint may now appear for the same zone, effectively defining a range. 13.1.7. 10.9.6. 17/04/09
- 5) A new table (11.c) has been added to the output .LPM file to list all origin and destination zonal totals before and after and to compare the two. 13.1.5. 10.9.6. 25/04/09.
- 6) The name of the output .ME2 file is now based on the output matrix filename (change .UFM to .ME2) rather than the counts file. 13.8. 10.9.8 13/06/09
- 7) The contents of the output .ME2 file have also been extended so as to include the link sensitivity variables as normally contained in Table 10 and described in 13.3.11. Also in 10.8.22. 05/05/09.
- 8) The original input “actual” counts from **SATPIJA** are now included in the .UFP file as well as the “demand” counts and passed to **SATME2** where they now appear in Table 1. They are also included within the .ME2 files passed to **P1X** where they may be displaced under ME2 Analysis. 10.9.13. 15/10/09.
- 9) The .ME2 files created by **SATME2** and passed to **P1X** now include information on the various namelist parameters set within both **SATME2** and **SATPIJA**. They may be displayed as a text window under ME2 Analysis in **P1X**. 10.9.13. 15/10/09.
- 10) The output .ME2 files contain the combined set number for counts that are combined into “screen lines” under 6666 and these may therefore be displayed in **P1X**. 10.9.18. 31/07/10.
- 11) **SATPIJA** now will correctly process PASSQ flows by individual user classes if the “pre” and “current” networks have different link structures. 10.9.19. 14/08/10.

- 12) **SATPIJA** may now process subsets of origin zones in “segments” or “slices” such that a full PIJA analysis may be broken down into multiple sub-steps, the main objective being to run each sub-step simultaneously within a separate core on a multi-core machine in order to save CPU. A subsequent run of **SATPIJA** will then aggregate each sub-file to create a normal full .UFP file. See 13.4.9. 10.9.21 24/11/10.
- 13) A new multi-core batch file SATPIJA\_MC has been created in order to use the “segmented” application of **SATPIJA** (see 12) above) in order to calculate a .UFP file using multiple processors with a consequent reduction in CPU time. See 15.53.2.2. 10.9.24. 20/04/11.

#### D.18.5 SATSUMA/SATTPX

- 1) QUIET option now allowed. See 14.9.
- 2) The first time period may now have a PASSQ flow input by defining PASSQ = T and FILPLD under &OPTION in the base network .dat file. See ??

#### D.18.6 SATDB

- 1) The minimum-maximum number of columns allowed in the link data base has been increased from 8 to 12. In other words if your network is at the limit of the number of assignment links then you can create at least 12 data columns, but if you are below the limit you may have up to 24 data columns.
- 2) The batch file satbuf has been updated to function properly for networks where DUTCH = T and link A- and B-nodes need to occupy 10 columns each, not 5, on the output file. See Section 15.8.2. 10.9.15. 05/02/10.

#### D.18.7 General

- 1) No .LOG files created when interactive programs such as **MX** or **P1X** are run in KEY + VDU mode. Also in 10.8.21. 12/01/09.
- 2) If the file sat10key.dat cannot be opened because it is temporarily in use by another program running in parallel the program pauses briefly and tries again. Also in 10.8.21. 15/01/09.
- 3) Unidentified “tokens” on a command line now result in Fatal Errors; e.g., trying to invoke PASSQ under **SATALL** instead of within **SATNET**. 10.9.7. 28/05/09.
- 4) Default .LP files created under commands such as MX I or even \$MX (to simply run the .exe file directly) are assigned names such as mx1.lpx, mx2.lpx, if the normal default file mx.lpx is currently open. This may occur if several jobs are being launched simultaneously. 10.9.8. 05/07/09.

- 5) The program **SATED** is no longer included with the standard .exe files since all its essential functions are embedded within **P1X**. 10.9.10.
- 6) LOG files have been made a bit more “robust” when converted to KEY files by replacing certain blank lines by their equivalent defaults. For example, if the reply to a Yes/No question was simply <return> implying the default of Yes, then “Yes” is written to the LOG file rather than a blank line. This then helps subsequent runs using KEY files to differentiate between certain inputs. 10.9.19. 19/08/10.
- 7) As a general rule – but as yet not universally applied – if an output text file has been given the extension .CSV then the output data is in “true” CSV format in the sense that a comma is inserted at the end of each numerical field. In particular this applies to the output of grand matrix totals in **MX**, Section 10.14. 10.9.20. 12/09/10.
- 8) All complete listings of network namelist parameters (i.e., logicals, integers and reals) now contain separate listings of just those parameters whose values differ from the standard defaults; e.g., in **SATNET**, **SATALL**, **P1X**, etc. 10.9.20. 20/09/10.
- 9) KEY files input to interactive programs previously had to have an extension .key; this rule has now been relaxed such that the extension .log is also permitted. This means that a LOG file produced by one program run may be used directly as a KEY file in a later run without the necessity to rename it with an extension .key. See 14.5.1. 10.9.21. 05/11/10.
- 10) In addition KEY and/or VDU files may be defined on a command line by virtue of their extension without necessarily following the keyword KEY or VDU. Thus instead of P1X net KEY jim one could write P1X net jim.key. Or equally P1X net jim.log. See 14.5.1. 10.9.22 15/12/10.

#### **D.18.8 P1X**

- 1) A red bar has been added on individual node plots to indicate when an exit and/or entry link is blocking back. Also in 10.8.21. See 11.2.2. 24/01/09
- 2) Blocking back values on both entry and exit links has been added to set 3 of the link data as displayed under individual node graphics. 24/01/09
- 3) An explicit option to print standard Node Table 2 (Flow and delay data) from within Node Graphics and/or the last table previously used has been added. Also in 10.8.21. See 11.2.3. 27.01/09
- 4) Output to .JPG files should now be operational. Also in 10.8.21. 01/02/09.
- 5) Differences in network coding of individual simulation nodes between networks 1 and 2 may now be “highlighted” and node graphics loops over those nodes that differ may be initiated. This is a very useful option for

discovering what other people have done to your network and not documented while you were on holiday! A complete table of differences per node is printed out automatically to the .LPP file (but, for the moment, can only be viewed by going to the .LPP file afterwards, not interactively). A similar option is also available in **SATLOOK**; see note 3) in D.18.9. See 11.6.5.4. 20/03/09.

- 6) Similarly within the **SATLOOK** standard text tables a new option, #25, has been added to print a full list of coding differences for an individual node. N.B. Only available when **SATLOOK** is called as a sub-component of **P1X**, not with **SATLOOK** as a free-standing program. See 11.11.1. 20/03/09.
- 7) Under network editing the 11111 data segment when \$INCLUDE files have been included **P1X** now keeps track of whether changes have been made to simulation nodes within individual \$INCLUDE files and offers the option at the end of node editing to only re-create those files which have been updated. 10.9.7. 10/05/09.
- 8) In node graphics it is now possible to jump directly to an adjacent node by clicking on its node number at the end of its arm on the current plot – rather than selecting the option from the banner and then clicking at the end of the arm. See 11.2.1. 10.9.7. 12/05/09.
- 9) Double clicking on a simulation node whilst in network plots will lead directly to node graphics for that node. See 11.2.1. 10.9.7. 20/05/09.
- 10) When editing simulation nodes under node graphics it is now possible to return directly to the same data field as previously edited without having to repeat all the intermediate steps. E.g., if you have recently re-set the saturation flow for one particular turn you may choose to repeat the identical operation with one mouse click. 10.9.7. 30/05/09.
- 11) The logical namelist variable PANDP in the “standard” preferences file P1X0.DAT has now been set to T (so that the “pick’n’plot” rule is applied when selecting new link data to annotate as opposed to “Add to D.B.”) in accordance with the default set within the program. Apparently it may have alternated between T and F in recent releases. If you prefer it to be F (e.g., because you have various key files implicitly that assume it is F) then you will need to amend your preferences file accordingly. 10.9.7. 01/06/09.
- 12) Forest display now includes measures of the path-averaged time, distance, speed, etc. etc. in the banner. 10.9.10. 30/07/09.
- 13) Around 20 extra items have been added to the lists of link data that may be selected for annotation to include, e.g., flows aggregated over vehicle classes, crow-fly distances and differences between crow-fly and coded link distances, links which are part of “chains”, simulation convergence statistics per link, etc. etc. See Appendix I.1. 10.9.13. 23/10/09.

- 14) Similarly extra items have been added to the list of simulation turn data as used either for network-wide turn annotation or for individual node graphics. See Appendix I.2. 10.9.13. 23/10/09.
- 15) The “housekeeping” menu under link display now contains an option to delete data base columns as well as to hide/display them. 10.9.13. 15/11/09.
- 16) The lists of “10 worst” convergence parameters now includes a measure of how much signalised junctions **might** be improved through signal optimisation ranked by the amount by which the maximum V/C ratio could be reduced. This helps to identify badly coded junctions which may be impeding convergence. 10.9.13. 01/12/09.
- 17) Options have been added so that when a new file containing X,Y coordinates is created the format may be changed (e.g., to CSV from fixed column) and the factor XYUNIT may be explicitly added so that the coordinates are output in units of metres. See 11.9.7. 10.9.14. 12/09/09.
- 18) The Select Link Analysis main menu now displays the filename of the trip matrix being assigned and allows it to be re-defined (so that if you want to do a SLA for network 2 you may also select the trip matrix from network 2). See 11.8.1.8. 10.9.15. 05/02/10.
- 19) The node graphics displays now explicitly plot flared lanes, both nearside and offside. See 11.12.2. 10.9.15. 01/02/10.
- 20) A new link data set consisting of “link properties” such as flare lengths may now be selected within node graphics. 10.9.15. 01/02/10.
- 21) A new “resume” option automatically creates (/overwrites if necessary) a file last\_p1x0.dat containing all the relevant parameters and window information at the point of exit from **P1X** such that that file may be picked up by the very next run of **P1X** enabling the next run to resume with the same conditions as the last. Extremely useful! See 11.4.4. 10.9.15. 13/02/10.
- 22) A link to the display of **all** individual bus routes has been added within the Validation menu; at present only those with timing points may be accessed. 26/03/10. 10.9.16.
- 23) An option to print a full table of bus route summary statistics (currently option 6 within **SATLOOK**) is now available under Information/Bus Routes/Options. 26/03/10. 10.9.16.
- 24) The validation of timed routes now permits an average turn delay to be included within the final simulation link of a timed route so as to be consistent with the other definitions of timing points. See 11.7.2.1. 31/03/10. 10.9.16.

- 25) A text output file may be created containing a full list of **all** nodes formed by the union of two topologically different networks with their common sequential node numbers. See 11.4.2. In turn this may be used by SATCOBA; see D.18.12. 10.9.16. 01/05/10.
- 26) The “double-click” option to select a node for node graphics is now entered into the log files and will be correctly recognised in subsequent key files. See 11.12.1. 10.9.17. 08/05/10.
- 27) The “resume option” (21 above) has been extended such that the file last\_p1x0.dat not only contains the co-ordinates of the **last** window used, it also remembers **all** the previously saved windows from the previous run (which might also be entered in a .WXY file). 10.9.17. 11/06/10.
- 28) Node graphics images may now be output as .JPG files. 10.9.17. 12/06/10.
- 29) The “resume option” (see 21) above) may also be invoked immediately on entry by including the key word “RESUME” on the command line. 10.9.18. 03/07/10.
- 30) The definition of “stack” as used in the calculation of QoverS has been changed so that it equals the value as used in blocking back calculations, i.e., the combined stacking capacity of the chain if the link is part of a chain of in-series links; otherwise the normal link stacking capacity. This avoids the “presentational” problem of Q/S values appearing as greater than 100% when in fact there is no blocking back on the link/chain. See 8.5.5.5. 10.9.18. 04/07/10.
- 31) The “vertical” or “global” editing of link data has been extended to include the capacity indices which are stored on the second link record. See 11.9.17. 10.9.18. 05/07/10.
- 32) Destination zones which cannot be reached from a particular origin during a “plot to all zones” tree build and which may be a consequence of a disconnected network are indicated by a large red X. See 11.8.3, option c). 10.9.18. 22/07/10.
- 33) While editing individual simulation nodes it is now possible to move to an adjacent node by clicking on its A-node number directly within the node plot rather than having to “quit” the current node and then select another node. 10.9.19. 19/08/10.
- 34) In the editing of simulation node data (e.g., within **PMAKE**) it is now assumed that any comment records that **precede** the node record the .dat file are part of that node’s records and they are therefore included within the editing process where they may be modified by screen editing. As previously any comment records within the node data are also included within editing but any comments at the **end** of the node records (i.e., beyond the link or signal data) are assumed to refer to the following node. See 11.9.3. 10.9.19. 19/08/10.

- 35) New little green arrows in the middle of each boundary line have been added to move the window up, down etc., along with arrows in the 4 corners to shift the window at 45 degrees plus two small circles with plus/minus signs to indicate zoom in/out. So the same functionality as appears on the menu bar as Nav-L etc. but hopefully more intuitive. See 11.5.5. 10.9.20. 14/09/10.
- 36) Editing link and/or turn data within node graphics has been easier by introducing small "target boxes" at the end of each arm to select a link or later a turn. Subsequent data editing is then based on the use of Windows edit boxes. See 11.12.4. 10.9.20. 14/09/10.
- 37) The "vertical field" editing may now use a single fixed value to be applied to all (or a selected subset of) nodes and/or links as opposed to defining individual values per node or link via an external data file or internal data base column. 10.9.21. 23/10/10.
- 38) The "auxiliary network plot" which shows the position of the current window within the full network now re-appears each time a new window is created. See 11.5.4. 10.9.21. 27/10/10.
- 39) The criteria for "selecting" nodes for display have been extended in order to select either (a) nodes which have been retained in a spider web aggregated network (15.56) or (b) are treated as "moons" or "dependent simulation nodes" within the simulation (8.5.3). See 11.6.5.3. 10.9.21. 21/11/10.
- 40) Within node graphics if two arms at a node are very near one another such that any notation (e.g., A-node numbers) at the end of the arms overlaps, the notation is moved sideways to eliminate the overlap. 10.9.21. 21/11/10.
- 41) The option to annotate bus flows on (nearside and/or offside) bus lanes has been extended to include flows on bus-only links. 10.9.23. 24/01/11.
- 42) All bus flows may be optionally displayed in units of either vehicles (i.e., buses) per hour or PCUs per hour – provided, for the moment that all buses have a common BUSPCU factor. 10.9.23. 25/01/11.
- 43) A "quick toggle" switch to swap between numerical and geometrical (e.g., bandwidth) link annotation is now provided. In most cases this will mean either numbers on links or bandwidths but if, say, the option to print numerical boxes was selected most recently from the full set of display options then that becomes the default "numerical" toggle. Ditto with alternative geometrical options such as variable intensity etc. 10.9.23. 19/02/11.
- 44) An option to temporarily "suspend" link selection has been added. Thus if there is a link selection rule in force it can be turned "inactive" without losing all the select information and therefore turned "active" at a later stage. 10.9.23. 20/02/11.

- 45) A number of “toggle options” have been added to the pull-down menus under Display and Windows on the menu bar. For example both the switches noted above under 43) and 44) are included under Display. Equally, for example, the option to print node numbers offset is also available under Display. 10.9.23. 19/02/11. The set of options available from the pull-down menus has been further extended under 10.9.24.
- 46) New options have been introduced to process .ERL files in which the two extra data fields have been used to distinguish, e.g., recently introduced errors from older ones. Development is ongoing but the basic idea is to allow a “selective” highlighting of various errors using information from the .ERL files rather than the complete list of errors as detected by **SATNET** and stored on the .UFS file. 10.9.23. 25/02/11.
- 47) Simulation zones which have identical centroid connectors may be aggregated into single zones under network editing / PMAKE using the lowest zone numbers. Common examples are multiple external zones all of which are connected onto a single external simulation node. See 11.9.4.1. 10.9.23. 09/03/11.
- 48) The batch file procedure SIGOPT (15.31.6) which makes use of **P1X** now edits stage times and/or offsets of those simulation nodes which have been coded within \$INCLUDE files by explicitly incorporating all such files within the new output .dat file. At the same time the sigopt.bat file itself has been upgraded to make it easier for the user to define the name of the new .dat file. 10.9.24. 30/03/11.
- 49) Data contained in .ERL (Error Listing) files may now be used to highlight those nodes that satisfy certain criteria based on the values in either of the two “extra” fields which may be manipulated by the users. For example, it is possible to externally assign different numerical values in the second field (e.g., using Excel) to indicate the degree of “urgency” associated with each particular error and to highlight these using different colours in **P1X**. See 11.6.5.4 and 15.58.2. 10.9.24. 22/04/11.
- 50) A command line such as “P1X network 485” causes the initial network window to be opened with node 485 in the middle. The option is invoked whenever a pure numerical value is input on the command line. 10.9.24. 27/05/11.

## D.18.9 SATLOOK

- 1) A facility to skim O-D time, distance and tolls simultaneously from a forest (as opposed to carrying out 2 or 3 separate skims in order to reduce CPU time by a factor of roughly 2 or 3) has been added. This may be called either interactively under main option 9, via a standard batch file SKIM\_ALL (cf SKIMTIME, etc.) or in SATTUBA. See 15.27.7. Also in 10.8.21. 24/01/09.

- 2) An option has been included within SATTUBA to exclude all times and **distances** on centroid connectors (which, in practice, means buffer centroid connectors) from skims on the assumption that they are essentially arbitrary. However toll skims continue to include centroid connectors. See XCCSK under 15.41.4. 10.9.8. 10/07/09.
- 3) An option to print all differences in coding between common simulation nodes in networks 1 and 2 is now available but only when **SATLOOK** is called as a sub-component of **P1X**. See also note 5) under D.18.8 above. See 11.11.18. 10.9.10. 14/08/09.
- 4) The filename conventions used in SATTUBA and SKIM\_ALL etc. have been changed such that an output time file net.t.ufm becomes net\_t.ufm; i.e., full stop becomes an underscore. 10.9.13. 01/12/09.
- 5) SKIM\_ALL now outputs up to 4 skimmed matrices by including a matrix of time penalties (in seconds) if any exist. 15.27.7. 10.9.16. 21/04/10.
- 6) A new set of O-D skimming algorithms have been introduced under standard batch procedures such as SKIM\_TIME, SKIM\_ALL, etc. etc which are more CPU-efficient than the old versions and also form the basis for new multi-core versions. On the other hand they use more RAM so, for that reason, they are only available in the standalone batch version of **SATLOOK**, not in the interactive versions and/or accessed via **P1X**. See 15.27.8. 10.9.17. 07/05/10.
- 7) Turning flows at (all) buffer nodes may now be output (a) to an external text file (as opposed to just the .LPL file) and (b) in a one-record-per-turn format (as opposed to an in-bound out-bound matrix format). See 11.11.12. 10.9.22. 28/12/10.

#### D.18.10 MX

- 1) The ratio of the maximum number of rows permitted relative to the maximum number of columns permitted has been increased from 3 to 6. This means that a matrix with 6 levels will always be accepted even if the number of rows/zones exactly equals its maximum. However, if you have fewer zones/rows than the maximum, the number of permitted levels will increase in proportion. 10.9.5. 20/03/09.
- 2) The maximum number of rows has been further increased to 9 times the columns/zones in order to provide even more “headroom” for stacked matrices in 10.9.13. 25/10/09.
- 3) An option to define sectors by zone interactively added. 10.9.8. 18/06/09
- 4) Matrices dumped in EMME/2 format to ascii (.txt) files may now have their number of decimal places defined. 10.9.8. 20/06/09.

- 5) The first matrix input into MX as part of standard matrix batch files MXADD, UFM2CSV, etc. etc. is now closed immediately after it has been read in in order to reduce the possibility that two separate applications of **MX** (or indeed any programs) operating in different cores will both try to open the same matrix file at the same time. 10.9.13. 23/10/09.
- 6) The QUIET option can now be included in the command line for M1 and MXM1 so that a matrix can be created from a .dat file without grabbing the screen at all. Release Version 10.9.14 09/12/09.
- 7) The standard batch files UFMSTACK and UFMUNSTACK now have an option to run in QUIET mode. Release Version 10.9.17. 09/06/10.
- 8) Further to 3) above a further option has been added to define sectors by zone using an explicit external text file which by default has the extension .Z2S and consists of one record per zone giving the zone name and its sector. See 10.2.5. 10.9.19. 27/08/10.
- 9) Equally a .Z2S filename may be included as a namelist parameter within a matrix .dat file such that the zone-to-sector conversion is permanently stored within the .ufm file structure. 10.9.19. 27/08/10.
- 10) Matrix row and/or column totals may now be output in a CSV format, basically one record per zone with options to in/exclude sequential row numbers, zone names, etc. etc. See Section 10.14. 10.9.20. 11/09/10.
- 11) "Cut" and "Paste" operations have been added such that an individual sub-matrix may be extracted (cut) to a .ufm file from a stacked matrix or a square input matrix may "over-write / paste" an existing level in an internal stacked matrix. See 10.4.2 and 10.16. 10.9.20. 22/09/10.
- 12) Factoring of selected areas of a matrix may now be easily applied to a single level only over a stacked matrix. See 10.7.2 and 10.7.3. 10.9.20. 22/09/10.
- 13) The procedures by which a .ufm matrix may be updated using text data read from a CSV file now allow the text file to be in fixed column format with spaces between each numerical entry rather than commas. In particular this applies to the batch file CSV2UFM. Note that UFM2CSV creates a text file which is "true" CSV (commas between values rather than spaces) so not a problem currently for re-input via CSV2UFM but that format might be altered if the file is processed and re-gurgitated by, say, Excel. 10.9.24. 17/03/11.
- 14) In addition, when updating a .UFM file from a CSV file, the row/zone names are now taken from the original input .ufm file rather than defaulting to sequential names as at present. 10.9.24. 16/03/11.

## D.18.11 SATCH

- 1) The default value of DEMAND has been changed to F; i.e., output trip matrices are based on actual flows, not demand flows, by default. 10.9.6. 17/04/09.
- 2) A second table has been added comparing O/D totals in the output trip matrix with the corresponding network flows **after** Furnessing has been carried out. 10.9.6. 17/04/09.
- 3) The batch file has been extended so that a single user class output trip matrix may be requested via the command line by including, eg., NOMAD 2 at the end of the line. Its primary function is to be used as part of a new multi-core distributed batch file SATCH\_MC described next. 10.9.24. 15/04/11.
- 4) Multiple user class matrices may now be produced "in parallel" using multiple processors via the batch file SATCH\_MC which allocates one user class per processor to produce a series of individual user class (square) trip matrices and then stacks them into the required multi-level trip matrix. (Yet to be finalised). See 12.1.6 and 15.23.2.6. 10.9.24. 22/04/11

#### D.18.12 SATCOBA

- 1) Two new options have been added to (a) output flows from a single network disaggregated by vehicle class (in addition to by user class) and b) to output such flows in units of either PCUs/hr or vph. See 15.42.2. 10.9.10. 13/08/09.
- 2) A new option permits a node conversion file to be input so that 5-digit node numbers may be converted to 4-digit numbers with the added benefit that the same conversions may be applied across any number of networks which may have different nodes included (e.g., do something vrs. Do-min). See 15.42.6. 10.9.16 01/05/10.

#### D.18.13 SATPIG

- 1) New options have been added to control (and in particular to increase) the number of paths output. Thus if ALLOD = T at least one route is included for every O-D pair whether or not it has any trips in its trip matrix cell. Equally a new parameter PODMIN sets an inclusion test based on a minimum fractional use of a path – in addition to FPHMIN which tests the absolute flow in pcu/hr. See 12.6. 10.9.10. 14/08/09.
- 2) Output files under TRPFOR = T now include both the absolute flow in pcus/hr **and** (new) the fractional flow on the first record for every route.
- 3) A option to output all path data in CSV format with all numbers on a single record has been introduced. Set the new Namelist Parameter CSVFOR = T. 10.9.24. 19/03/11



#### D.18.14 CASSINI

- 1) A new program to enable Network parameters such as MASL, NITA etc. to be adjusted between external demand loops dependent on the level of convergence reported by the demand model (e.g., DIADEM) in order to "relax" the convergence criteria for the SATURN assignment. See 15.54. 10.9.10 04/09/09
- 2) Renaming of the CASTXT options to either 'DIADEM' (the default value) or 'Other'; previous versions had problems in selecting non-DIADEM formats for CASSINI to correctly read-in. See 15.54 10.9.22 06/12/10

#### D.18.15 SATWIN

- 1) Option to link the various files used by **SATURN** to their respective programs within Windows Explorer. See 3.6.6. 10.9.12 26/10/09.
- 2) Increase in the number of different sets of **SATURN** executables that may be selected on the start-up screen from 10 to 15. See 3.6.1. 10.9.12 26/10/09.
- 3) For each event, the selected working folder and program folder are saved to enable previous 'events' to be re-run more easily. Option to 'save' event log for subsequent re-importing back into **SATWIN**. See 3.6.5. 10.9.12 26/10/09.
- 4) Location of temporary SATWIN.BAT files moved to core install directory (eg C:\SATWIN\TEMP)
- 5) New options to select QUICK / QUIET = TRUE for all **SATURN** programs through toggle option. See 15.55 10.9.10 04/09/09.
- 6) Introduction of a new 'Non-Core Alternatives' sub-menu that enables users to run either:
  - the previous v10.9.12 releases of SATNET and SATALL exe's rather than the new SATURN 10.9.17 versions (as called by SATNETX.BAT and SATALLX.BAT separately or SATURNX.BAT combined); or
  - a hybrid option of SATNET v10.9.17 and SATALL v10.9.12 (as accessed by SATNET.BAT and SATALLX.BAT separately and SATURNH.BAT combined) that will provide the benefits of more comprehensive network coding checks whilst still using the earlier SATALL version.

NB: replaced with v10.9.22 and v10.9.17 hybrid. 10.9.22 26/01/11

NB: replaced with v10.9.24 and v10.9.22 hybrid. 10.9.24 31/05/11

- 7) New 'Developer' option under the Module sub-menu to provide access to DACHEX, DADUMP, DALOAD and DALOOK 10.9.22 06/12/10
- 8) Labels added to the SATWIN Module menu and dialogue boxes to aid identification, re-grouping of modules into new 'application' groups and review of supplied batch files and modules. 10.9.24 31/05/11
- 9) Multi-core options available (as indicated by '+MC' suffix) within the SATWIN modules for SATPIJA, SATUFO and SATCH operations. 10.9.24 31/05/11.
- 10) Settings option to manually select P1X0.DAT version (e.g. v10.9.17) for the appropriate \$P1X.EXE being used. This resolves a problem with backward compatibility between the P1X0.DAT and the \$P1X.EXE introduced with 10.9.17. P1X may crash with a Runtime Error 52: 'Invalid character in field'. Users are able to select the DAT file to use from the 'Settings' menu. (NB: an automated system will be introduced at a later date) 10.9.24 31/05/11.
- 11) New option to access the Beta version of SATLOOK (SATLOOKB) via Modules -> Beta versions. 10.9.24 13/08/11

#### **D.18.16 Documentation**

- 1) Full updates have been carried out for the November 2009 release of 10.9.12 as well as for 10.9.17 in June 2010, 10.9.22 in January 2011 and 10.9.24 in May 2011.
- 2) The 10.9.17 release contains new Appendices R, S and T which contain print-outs of two recent ETC papers on OBA, CASSINI and Network Aggregation plus a copy of a more ancient paper by DVV on tree-building algorithms which is relevant to network aggregation.

DVV / IW 13/08/11



## D.19 Version Control

JOB NUMBER: 5101396		DOCUMENT REF : App D18.doc				
Revision	Purpose / Description					
		Originated	Checked	Reviewed	Authorised	Date
1	First additions	DVV				16/03/07
2 to 3.4	New document extract					
3.5	Web Release for Jul 07	DVV	NP	IW	IW	19/07/07
3.6	SATURN v10.8 Release	DVV	NP	IW	IW	19/03/08
	Post Full Release Updates	DVV				25/04/08
3.7	Web Release for Jul 08	DVV	NP	IW	IW	07/07/08
3.8	Web release – Dec 08	DVV	NP	IW	IW	12/12/08
3.8.21	Web release – Feb 09	DVV	NP	IW	IW	16/02/09
3.8.22	Web release – Jun 09	DVV	NP	IW	IW	25/06/09
10.9.10	SATURN v10.9 Release	DVV	DG	IW	IW	04/09/09
10.9.12	SATURN v10.9 Release (Full)	DVV	DG	IW	IW	29/10/09
10.9.17	Web release – Jun 10	DVV	NP	IW	IW	22/06/10
10.9.22	Web release – Dec 10	DVV	AG	IW	IW	06/12/10
10.9.24	SATURN v10.9 Release (Full)	DVV	AG	IW	IW	31/05/11
	Interim Update – Aug 11	DVV	AG	IW	IW	13/08/11